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Liomys adspersus.

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Liomys adspersus (Peters, 1874)

Peter's Spiny Pocket Mouse

Heteromys adspersus Peters, 1874:357. Type locality "Panama."
Liomys adspersus: Goldman, 1920:51. First use of current name combination and restriction of type locality to Panama City.

CONTEXT AND CONTENT. Order Rodentia, family Heteromyidae, subfamily Heteromyinae. *Liomys adspersus* is monotypic.

DIAGNOSIS. Peter's spiny pocket mouse (Fig. 1) is the largest species in the genus; *L. adspersus* is larger than *L. salvini* for all external and cranial characters with the exception of interparietal width, which averages broader in *L. salvini*. Pterygoids (Fig. 2) are narrow. Premolars in *L. adspersus* are similar in structure to those of *L. salvini*. *L. adspersus* and *L. salvini* also are similar in the morphology of the bacula and glans; however, the glans of *L. adspersus* is shorter in comparison with length of the baculum. Both species have 56 chromosomes, but *L. adspersus* has at least 1 fewer pair of metacentric chromosomes (fundamental number = 84 or less in *L. adspersus* and 86 in *L. salvini*). The structure of the head and neck of the spermatozoon of *L. adspersus* resembles that of *L. salvini*, but the head of the sperm of *L. adspersus* is significantly narrower than that of *L. salvini* and the neck between the head and the midpiece is significantly longer in *L. adspersus* than in *L. salvini* (Genoways 1973).

GENERAL CHARACTERS. Dorsal pelage of *L. adspersus* ranges from chocolate brown to gray brown and is interspersed with dark spines and orange hairs. Underparts, limbs, and feet are yellowish white. Tail is bicolored, moderately haired, and about equal to length of head and body. Soles of hind feet are haired from heel to basal pad and contain 6 plantar pads.

Males are significantly larger than females in total length, length of tail, greatest length of skull, zygomatic breadth, length of nasals, length of rostrum, and depth of braincase (Best 1993; Genoways 1973). Means, followed by sample size and ranges within parentheses, of representative external and cranial measurements (in mm) of males and females, respectively, are as follows: total length, 260.2 (29, 232–285), 247.2 (21, 222–265); length of tail, 128.8 (29, 107–148), 124.9 (21, 109–138); length of hind foot, 30.6 (35, 26–34), 30.3 (27, 28–32); greatest length of skull, 35.5 (33, 32.2–38.9), 34.8 (26, 32.9–36.2); zygomatic breadth, 16.5 (12, 15.1–17.4), 16.5 (13, 15.8–17.5); interorbital constriction, 7.5 (36, 7.0–8.1), 7.5 (28, 7.0–8.2); mastoid breadth, 14.7 (34, 13.8–15.6), 14.6 (27, 13.8–15.2); length of nasals, 14.6 (35, 12.8–17.3), 14.1 (27, 13.0–15.2); length of rostrum, 15.9 (27, 15.0–17.9), 15.4 (21, 14.5–16.3); length of maxillary toothrow, 5.3 (34, 4.9–5.9), 5.3 (28, 5.0–5.6); depth of braincase, 9.6 (33, 8.8–10.2), 9.3 (26, 8.7–9.9); interparietal width, 8.4 (26, 7.2–9.3), 8.4 (26, 7.5–9.6); and interparietal length, 4.6 (30, 3.4–5.2), 4.4 (27, 3.8–5.2).

DISTRIBUTION. *Liomys adspersus* is found on the lowland Pacific coast of central and western Panama below 600 m and in savannas in the headwater region of the Caribbean drainage (Fig. 3) near the Canal Zone (Méndez 1993). It occurs from Guabula in the west to Chepo in the east, southward through the Peninsula del Azuero, and northward to the Canal Zonal (Genoways 1973).

FOSSIL RECORD. Bone elements of *L. adspersus* occur at Sitio Sierra, an archaeological site in Herrera Province (Cooke et al. 1985). This site, dated between 300 BC and AD 500, is within the current distribution of the species.

FORM AND FUNCTION. Dental formula is i 1/1, c 0/0, p 1/1, m 3/3, total 20. Protoloph of upper premolar has a single cusp, the protocone, because the 2 lateral cusps are compressed against it and are indistinguishable (Wood and Wilson 1936). Crescent-shaped metaloph is composed of 3 and sometimes 4 cusps. Metacone of metaloph is sometimes larger than hypocone. In *L. adspersus*, an extra cusp on premolars of many specimens is the result of a deep reentrant angle of enamel that divides a loph, extending from hypocone toward entostyle. Entostyle is distinctly separated from other cusps of metaloph; it is placed anteriorly and lingually to hypocone and is separated from other cusps of metaloph by a reentrant angle of median valley (Genoways 1973). Protolophid of lower premolars has 3 cusps that are weakly defined because of the shallow enamel angle that separates them. Mesoconid and protoconid are about equal in size and only slightly separated at their posteromedial borders. Anteroconid has 2 cusps, which are weakly separated from protoconid and mesoconid. Near the center of this loph is a deep pit of enamel where the reentrant angles converge between the cusps. All cusps are united simultaneously early in the wear of the tooth, which results in an island of enamel near the center of the loph (Genoways 1973). The reentrant angle of enamel extends to unite with the deep median valley of enamel separating protolophid and metalophid, which results in the isolation of the hypoconid on the labial margin of the tooth. Posterior to this angle of enamel is a posterior cingulum. Separation of the hypoconid is longer than separation of cusps of protolophid, but eventually hypoconid and metaconid unite to form a single straight loph (Genoways 1973). Each upper and lower molar has 2 lophs (protoloph or metalophid and metaloph or hypolophid) separated by a median valley of enamel. For only a short period after the tooth has erupted, the 3 cusps that comprise the lophs are distinguishable. An island of enamel on M1 is rare and may reflect the similar depth of the enamel at the center of the tooth and at the labial margins (Genoways 1973). Pterygoid bones are narrow (Genoways 1973).

Liomys adspersus may have 3 pelages. A juvenile pelage has not been observed, and may be shed immediately after the body is covered completely with hair (Fleming 1970). In the Rodman Forest of the Canal Zone, the 2nd pelage, during the transition from subadult to adult, begins once the individual reaches 101–103 mm. Pelage replacement is initiated on the cheeks, forehead, and an isolated middorsal spot. The middorsal spot expands anteriorly and posteriorly until the entire dorsal area is covered with adult pelage; molting then progresses laterally and ventrally (Fleming 1970). The

FIG. 1. *Liomys adspersus* from Península del Azuero, Panama. Used with permission of the photographer A. Armien.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Liomys adspersus* from Fort Kobbe, Canal Zone, Panama (adult male United States National Museum [USNM] 298877). Occipital nasal length is 34.15 mm. Used with permission of the photographer S. Peurach (USNM).

soft aristiforms are replaced by stiff aristiforms at the same time. Adults obtain their 3rd pelage when ca. 1 year old during or at the end of the breeding season. This molt follows the same sequence as the subadult–adult phase; at this same time worn aristiforms and most likely setiforms are replaced. Examination of additional data from specimens of *L. adspersus* collected along the Pacific slope of western Panama indicates that one-half of the adult specimens were molting in January and three-fourths of adult specimens were molting in February, which is somewhat earlier that those molting in the Canal Zone. Molting has been observed in January, February, April, May, June, August, and September (Genoways 1973).

Glans of *L. adspersus* is cylindrical and broadest near midpoint. Ratio of length of glans to length of the baculum is between 66 and 69%. Diameter (3.00–3.35 mm) is small compared to length (5.8–6.4 mm). Tip extends only a short distance beyond main body of glans, with ca. equal lengths exposed both dorsally and ventrally. Rim of the terminal crater forms a broadly rounded V on dorsal and ventral sides. Rim is relatively smooth above and deeply crenate below. Urethral lappets are bilobed and medial lobe is larger. Baculum has a large rounded base where the shaft tapers steeply to a point just posterior to the slightly upturned tip, where it is dorsoventrally flattened. In *L. adspersus*, the tip of the shaft does not flare laterally nor does the tip turn upward to the same degree as in *L. salvini* (Genoways 1973).

Head of the sperm is short (average 3.17 mm, range 3.00–3.32 mm), broadest at the basal region, and rounded bluntly at the apex; it is narrow (average 2.8 mm, range 2.57–3.06 mm). Neck of the spermatozoa is long (average 0.75 mm, range 0.60–0.88 mm).

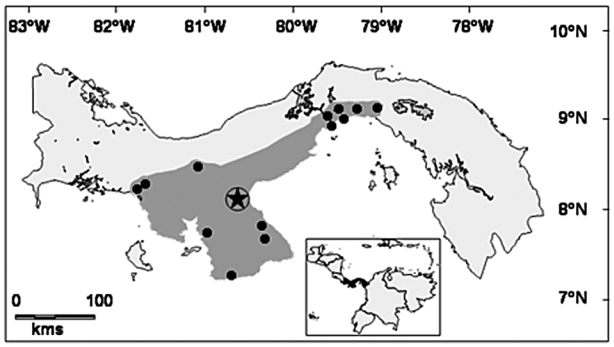

FIG. 3. Geographic distribution of *Liomys adspersus*. The star represents Sitio Sierra, a fossil site (Cooke et al. 1985). Map redrawn from Genoways (1973) with modifications (Méndez 1993).

The base is slightly concave at the point of attachment at the neck (Genoways 1973).

REPRODUCTION. *Liomys adspersus* produces an average of 1.4 litters per year, with an average litter size of 3.2 and a range from 2 to 4 (n = 19—Fleming 1971). Adult males and females in the Canal Zone show a seasonal pattern of reproductive activity, with peaks in the dry and early wet seasons (Fleming 1970). They breed from December to May. The dry season of the Canal Zone is from January through mid-April and the wet season begins in mid-April and ends in December (Sanchez-Cordero and Fleming 1993).

At La Pacifica, 70% of females were reproductive in the dry season, but reproduction did not occur for 7 months of the year (Fleming 1971). Based upon a pregnant adult female captured on 8 November 1961, 85 km west of the Canal Zone near Rio Hato, *L. adspersus* from the savannas of western Panama may breed earlier than those in the Canal Zone (Fleming 1970). Life span of *Liomys adspersus* is usually less than a year in the wild, although a few individuals may survive for 18 months (Fleming 1971). Survivorship in *L. adspersus* is 28% (Sanchez-Cordero and Fleming 1993).

ECOLOGY. *Liomys adspersus* is terrestrial and nocturnal (Méndez 1993) and constructs elaborate burrow systems with several entrances (Fleming 1974). Peter's spiny pocket mouse was abundant and common in thorny scrub and weedy fields of the semiarid savannah country of the Pacific coast of western and central Panama (Handley 1966). At the Rodman Forest in the Panama Canal Zone, the habitat of *L. adspersus* consisted of small hills and valleys covered with secondary-growth forests and grassy fields. The typical early secondary-growth forests of this region consisted of trees such as *Bursera simaruba*, *Cordia alliodora*, *Guazuma ulmifolia*, and *Luchea seemanii*, ranging from 4 to 20 m in height and forming an incomplete closed canopy. Several species of palm trees (*Bactris balanoides*, *Corozo oleifera*, and *Scheelea rostrata*) also occurred in this area, along with thick masses of thorny vines and shrubs (Fleming 1970).

Liomys adspersus was fairly common in the Rodman Forest of the Panama Canal Zone. Average home range was ca. 0.56 ha (data for 28 females and 18 males), with population densities ranging from 5.4 to 11.0 individuals/ha (Fleming 1971). Home-range size did not differ between sexes; however, males moved greater distances than females (average maximum of 95.9 m for 8 males and 45.3 m for 22 females—Fleming 1971). In *L. adspersus* ". . . home ranges were oriented randomly with respect to members of the same or opposite sex" (Fleming 1971:53). Also, average and maximum differences between captures were significantly greater for males than for females.

Densities of *L. adspersus* fluctuated seasonally. At Rodman Forest, densities of *L. adspersus* averaged 10 individuals/ha during the 1966 rainy season, and declined to 5 individuals/ha during the dry season (Sanchez-Cordero and Fleming 1993). Recruitment of juveniles began in the dry season and peaked early in the rainy season of 1967 (Fleming 1971).

Liomys adspersus is important in the life cycle of the bacterium *Leptospira interrogans* s.l., causative agent of leptospirosis (Gale et al. 1966). Eighteen species of mites are currently known from *L. adspersus*, including *Androlaelaps fahrenholzi*, *Ascos-*

choengastia dyscrita, *Colicus liomys*, *Crotonasis fissa*, *Echinonyssus microchelae*, *Eutrombicula goeldii*, *Hirstionyssus microchelae*, *Leptotrombidium panamense*, *Odontacarus fieldi*, *Odontacarus tuberculatis*, *Ornithonyssus bacoti*, *Polylopadium kramisi*, *Pseudoschoengatia bulbifera*, *Pseudoschoengastia tricosa*, *Pseudoschoengastia zona*, *Steptolaelaps heteromys*, *Trombicula liomys*, and *Vanidicus tricosus*. One ixodid tick (*Amblyomma*), 1 louse (*Fahrenholzia fairchildi*), 1 nematode (*Angiostrongylus costaricensis*), and 3 species of fleas (*Ctenocephalides felis*, *Polygenis dunni*, and *P. klagesi*) were found on *L. adspersus* (Genoways 1973; Tesh et al. 1973; Wenzel and Tipton 1966; Whitaker et al. 1993).

BEHAVIOR. The diet of Peter's spiny pocket mouse consists of nuts from the palm trees *S. rostrata* and *B. balanoides*, other plant material, and insects (Fleming 1970). Seeds are transported in cheek pouches and stored in the burrow or shallow pits nearby (Fleming and Brown 1975). This species detects seeds by odor and can locate seeds buried in dung. Where common, it is an important seed predator but may also act as a seed disperser, because some of its caches of seeds may be forgotten. Individuals are solitary and fight fiercely if placed together in captivity; however, in the wild, home ranges may overlap (Sanchez-Cordero and Fleming 1993).

GENETICS. *Liomys adspersus* presents a diploid chromosome number of 56; autosomes include 15 pairs of metacentrics and 12 pairs of telocentrics (Genoways 1973; Patton and Rogers 1993a). The X chromosome is a large submetacentric and the Y chromosome is a medium-sized metacentric. Fundamental number is 84. An individual of *L. adspersus* from near Fort Clayton (in the Canal Zone) showed a proportion of polymorphic loci of 3.3% and a proportion of heterozygous loci of 0.3% (Patton and Rogers 1993b).

CONSERVATION STATUS. *Liomys adspersus* is characterized as Low Risk, but close to qualifying as Vulnerable because of its restricted range and the ongoing destruction of its habitat (International Union for the Conservation of Nature 2002). However, populations of this species were considered to be "at good levels" (Méndez 1993:91). Nonetheless, populations are being protected in the following areas: Parque Nacional Cerro Hoya, Parque Nacional Metropolitano (Goldman 1920), and Parque Nacional Cruces (Genoways 1973).

REMARKS. *Liomys adspersus* is morphologically, karyotypically (Genoways 1973), and genetically (Rogers 1990) closely related to *L. salvini*, whose range ends 300 km to the north of that of *L. adspersus*. *L. salvini* and *L. adspersus* are placed together in the *salvini* group (Genoways 1973). This group was later formalized by inclusion into the undiagnosed subgenus *Schaeferia* (Von Lehmann and Schaefer 1979).

The name *adspersus* is Latin for sprinkle, splatter, and splash and likely refers to the dorsal color of the species. The Spanish common name is ratón de bolsas rosillo.

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